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POPULATION AND COMMUNITY RESPONSES OF SMALL MAMMALS TO 2,4,5-T

by

Gordon L. Kirkland, Jr.[1]

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ABSTRACT

The population and community responses of small mammals to application of the herbicide 2,4,5-T were studied on the Fernow Experimental Forest, Parsons, West Virginia. Data from live-trap and snap-trap sampling of small mammals before and after herbicide treatment revealed either neutral or positive responses. There was a significant correlation between the ranked order of abundance of species in pretreatment and posttreatment samples; this indicated that no major shift in community composition had occurred. Total numbers of small mammals tended to increase after aerial application of the herbicide. Shrews (Soricidae) and mice (Cricetinae) increased significantly; voles (Microtinae) declined slightly. The decrease in the abundance of microtine rodents resulted from a differential decline in the abundance of diurnal species.

KEYWORDS: Herbicide side effects, population dynamics, animal populations, Mammalia, herbicides (-forest weed control, 2,4,5-T.

1/ Curator, The Vertebrate Museum, Shippensburg State College, Shippensburg, Pennsylvania.

INTRODUCTION

On August 5, 1975, watershed 6 (WS-6) on the Fernow Experimental Forest near Parsons, West Virginia, was treated with an aerial application of the herbicide 2,4,5-T[2/] to release planted Norway spruce *(Picea abies)*[3/] from competing vegetation. This provided an opportunity to examine the responses of small mammals to the herbicide. Small mammal populations on WS-6, which had previously been sampled in October 1974, were sampled in July and October 1975 and July and August 1976. Based on the results of these 2,640 trap nights (TN) of sampling effort, this note presents an assessment of the population and community responses of small mammals to the 2,4,5-T treatment of WS-6.

SITE DESCRIPTION

Watershed 6 is located 3.6 km south and 0.7 km west of Parsons, Tucker County. The study site has a mean elevation of 820 m with a general southeast aspect. In 1963, the mixed deciduous forests, dominated by chestnut oak *(Quercus prinus)* and northern red oak *(Q. rubra)*, were clearcut and herbicides applied for six succeeding growing seasons. Since 1969, succession on the watershed has been allowed to proceed; in July 1975 the watershed was characterized by a mosaic of saplings and shrubs, interspersed with patches of grasses and ferns. Dominant tree species were black locust *(Robinia pseudoacacia)*, sumac *(Rhus* sp.*)*, cherry *(Prunus* sp.*)*, devil's walking stick *(Aralia spinosa)*, tulip poplar *(Liriodendron tulipifera)*, sugar maple *(Acer saccharum)*, and yellow birch *(Betula lenta)*. Blackberry and raspberry *(Rubus* spp.*)* were abundant.

METHODS AND MATERIALS

The 2,4,5-T was applied as a propylene glycol butyl ester in a water and oil emulsion by helicopter with a microfoil boom. Each 0.405 ha of the 21.45-ha watershed received 4.41 kg of 2,4,5-T (acid equivalent) in 1.89 liters of no. 2 diesel oil mixed with water to make 18.93 liters. The herbicide killed or controlled all vegetation except grasses and ferns. An estimated 85 to 95 percent of the foliage of woody species, including *Rubus*, was killed. Following herbicide treatment, patches of grasses and ferns appeared as green islands in a brown landscape.

Small mammals were sampled on one live-trap and two snap-trap grids. Each grid consisted of 80 stations with 15.25 m between lines and stations, for an effective sampling area of 1.86 ha. At each station, three traps were set within 1 m of the station marker. Museum Special[4/] breakback snap traps were used on the snap-trap grids, and 7.6- by 8.9- by 22.9-cm Sherman live traps on the live-trap grid. All traps were baited with rolled oats. Specimens captured alive were marked by clipping their toes; they were released at the site of capture. The goal of releasing seedling spruce from competition by application of 2,4,5-T on all of WS-6 precluded the establishment of an untreated grid as a control.

[2/] (2,4,5-trichlorophenoxy) acetic acid.

[3/] Authorities for scientific names are: Fernald (1950) for trees, Hall and Kelson (1959) for mammals and for family names.

[4/] Mention of products by name is for the information and convenience of the reader and does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

Grids were run for 3 nights in July but only 2 nights in October because of the limitations of weekend sampling. The grid types and sampling dates were: grid A, snap trap, October 18-20, 1974; grid B, snap trap, October 24-26, 1975; and grid C, live trap, July 28-31, and October 24-26, 1975, and July 30 and August 1, 1976.

RESULTS AND DISCUSSION

A total of 286 small mammals representing nine species were trapped (table 1). Statistical analyses of capture data from preherbicide and postherbicide sampling determined that quantitative and qualitative changes in the resident small mammal community generally were not pronounced.

Table 1--*Mammals captured and selected population parameters for three sampling grids before and after application of 2,4,5-T on watershed 6, Fernow Experimental Forest*

	Before application of herbicide			After application of herbicide			
Sampling grid	A	C	Total	B	C	C	Total
Date sampled	10/74	7/75		10/75	10/75	7-8/76	
Capture method[1/]	K	L		K	L	L	
Number of trap nights	480	720	1,200	480	480	480	1,440
Short-tailed shrew *(Blarina brevicauda)*	12	8	20	21	20	3	44
Masked shrew *(Sorex cinereus)*	4		4	3	1		4
Smokey shrew *(Sorex fumeus)*	6	1	7	16	8	6	30
Deer mouse *(Peromyscus maniculatus)*	11	12	23	16	35	6	57
White-footed mouse *(Peromyscus leucopus)*		7	7	5	1		6
Meadow vole *(Microtus pennsylvanicus)*	8		8	2			2
Southern bog lemming *(Synaptomys cooperi)*	3		3				
Red-backed vole *(Clethrionomys gapperi)*	10	18	28	11	24	7	42
Woodland jumping mouse *(Napaeozapus insignis)*		1	1				
Total	54	47	101	74	89	22	185
Catch per 100 trap nights	11.3	6.5	8.4	15.4	18.4	4.6	12.8
Soricids (percent)	40.7	19.1	30.7	54.1	34.5	40.9	42.2
Cricetines (percent)	20.4	40.4	29.7	28.4	42.9	27.3	34.1
Microtines (percent)	38.8	38.3	38.6	17.6	28.6	31.8	23.8

[1/] K means a snaptrap was used; L means a live trap was used.

The ranked order of abundance of species did not change significantly after herbicide treatment. Spearman Rank Correlation analysis (Siegel 1956) of capture totals from pre-treatment and posttreatment samples revealed a significant correlation between the relative abundance of species before and after the herbicide was applied ($r_s = 0.84$, $p < 0.01$). This was in spite of the failure after the herbicide application to capture two species present in pre-treatment samples; however, the southern bog lemming *(Synaptomys cooperi)* and the woodland jumping mouse *(Napaeozapus insignis)*, were the two least abundant species before application of the herbicide. *N. insignis* likely was in hibernation during the October sampling periods (Whitaker and Wrigley 1972).

The abundance of small mammals as measured by catch per unit sampling effort (number of captures per 100 TN) tended to be greater in postherbicide treatment samples. The increase in abundance of small mammals on the snap-trap grids between October 1974 (grid A, 11.3 per 100 TN) and October 1975 (grid B, 15.4 per 100 TN) was not statistically significant. There was a slight decrease in the relative abundance on the live-trap grid (C) between July 1975 (6.5 per 100 TN) and July and August 1976 (4.6 per 100 TN). The relative abundance of small mammals on the live-trap grid (C), however, increased significantly between July (6.5 per 100 TN) and October (18.4 per 100 TN) 1975 ($\chi^2 = 36.67$, $p < 0.001$).

Equally as important as the significant increase in abundance of small mammals on the live-trap grid between July and October 1975 was the recapture in October of 18 of 44 individuals marked in July (table 2). This 41-percent recapture rate verified a substantial survival of individuals on the sampling grid immediately prior to herbicide treatment and permitted rejection of the hypothesis that the October 1975 small mammal population on WS-6 was composed of individuals that had immigrated to the area after extirpation of the original population by the herbicide treatment. Instead, the October 1975 population consisted of individuals present before the treatment, plus others added through birth or immigration.

Table 2--*Mammals recaptured on live-trap grid, watershed 6, Fernow Experimental Forest*

Species	Number marked July 1975	Number recaptured October 1975	Percent
Blarina brevicauda	7	2	28.6
Sorex fumeus	1	0	0
Peromyscus maniculatus	12	9	75.0
Peromyscus leucopus	7	1	14.3
Clethrionomys gapperi	16	6	37.5
Napaeozapus insignis	1	0	0
Total	44	18	--

Comparison of pretreatment and posttreatment samples of small mammals reveals changes in the relative abundance and community composition of shrews (Soricidae), mice (Cricetinae), and voles (Microtinae). After treatment, the proportions of soricids and cricetines in the samples increased, whereas that of microtines decreased. Analyses of these changes with a z-test for differences in proportions (Zar 1974) indicate that the changes in soricids from 30.7 percent in pretreatment samples to 42.2 percent in posttreatment samples and in cricetines from 29.7 to 34.1 percent were not statistically significant at the 0.05 level. The decrease in the proportion of microtines in the samples, however, from 38.6 percent in pretreatment samples to 23.8 percent after herbicide treatment was significant ($z = 2.64$, $p < 0.01$).

These changes in community composition reflect shifts in the relative abundance (catch per 100 TN) of these groups before and after treatment. Soricids increased significantly from 2.58 per 100 TN to 5.42 per 100 TN ($\chi^2 = 12.72$, $p < 0.001$), as did cricetines from 2.50 per 100 TN to 4.38 per 100 TN ($\chi^2 = 6.53$, $p < 0.02$). In contrast, numbers of microtines declined slightly from 3.25 per 100 TN to 3.06 per 100 TN. Thus, the shift in the proportion of microtines (grazers) after treatment resulted from their failure to increase in abundance while the other two taxa increased significantly.

Of the three groups of mammals, the microtines should be the most likely to be adversely affected by the herbicide. Being primarily grazers, they might be affected by the decrease in vegetative food resources and/or by ingestion of the herbicide. The food habits of the cricetines and soricids should render them less susceptible to either of these effects, since the former are predominantly seed eaters and the latter insectivores.

The failure of the Microtinae to increase in abundance after the herbicide treatment may also be related to the loss of vegetative cover. In this study, two types of microtines were captured, primarily diurnal grassland species--the meadow vole *(Microtus pennsylvanicus)*, the bog lemming and a more nocturnal forest-dwelling species, the red-backed vole *(Clethrionomys gapperi)*. The trapping data reveal differential population responses in these two types of microtines. *Microtus pennsylvanicus* and *S. cooperi* declined significantly from 0.92 per 100 TN before the herbicide was applied to 0.14 per 100 TN after treatment ($\chi^2 = 8.03$, $p < 0.01$). During the same period, *C. gapperi* increased from 2.33 per 100 TN to 2.97 per 100 TN. Thus, the overall decline in microtines after treatment is attributable to the differential decrease in the abundance of the diurnal grassland species, possibly as a result of being exposed to increased predator pressure through the loss of vegetative cover. Birney et al. (1976) note that a minimal level of vegetative cover is necessary to permit *Microtus* spp. to increase in numbers during multiannual population fluctuations, and that insufficient cover exposes diurnal *Microtus* to increased predation from vision-oriented diurnal predators.

Other species of small mammals were not similarly affected for several reasons. Members of the genus *Peromyscus* are almost exclusively nocturnal, and *Clethrionomys* *gapperi* are most active from sunset to sunrise (Banfield 1974). Although soricids are generally active throughout each 24-hour day, they may be exposed to less diurnal predator pressure than microtines because of their small size. In addition, *Blarina brevicauda* is most active under the leaf and grass litter and in the tunnels it constructs below the surface of the soil.

CONCLUSIONS AND SUMMARY

In spite of the logical assumption that the application of 2,4,5-T and/or the accompanying habitat alterations might have produced a general negative response in the original small mammal community, data from this study reveal that only the microtines responded negatively. The food habits and behavior of some species of the Microtinae may have made them more sensitive than either the cricetines or soricids to the impact of the herbicide. In spite of increases and decreases in the abundance of various species, community composition, as measured by the ranked order of abundance of species in pretreatment and posttreatment samples, did not change significantly. Total small mammal abundance either remained statistically unchanged or increased after herbicide treatment. The increase in small mammal abundance between July and October 1975 may have represented a normal seasonal fluctuation rather than a positive response to the herbicide.

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LITERATURE CITED

Banfield, A. F. W.
1974. The mammals of Canada. 438 p. Univ. Toronto Press.

Birney, E. C., W. E. Grant, and D. D. Baird.
1976. Importance of vegetative cover to cycles of *Microtus* populations. Ecology 57(5):1043-1051.

Fernald, M. L.
1950. Gray's manual of botany. 8th ed. 1,632 p. D. Van Nostrand Co., New York.

Hall, E. R., and K. R. Kelson.
1959. Mammals of North America. 1,089 p., Ronald Press, New York.

Siegel, S.
1956. Nonparametric statistics for the behavioral sciences. 312 p., McGraw-Hill Book Co., New York.

Whitaker, J. O., Jr., and R. E. Wrigley.
1972. *Napaeozapus insignis*. Mamm. Species 14:1-6.

Zar, J. H.
1974. Biostatistical analysis. 620 p. Prentice-Hall, Englewood Cliffs, N. J.

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